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VEHICLE DETECTION, COUNTING AND CLASSIFICATION

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Abstract— **Detecting moving objects in videos is an important task in several computer vision applications, human interaction, monitoring of traffic and Structural Health Monitoring. When stationary camera is placed, a basic method to detect the objects of interest is background subtraction. However, precise moving object detection using such a method is an extremely difficult task in a varying environment. This paper introduces a new technique for detecting, counting and classification of the vehicles. As more vehicles continuously appear on the roads which causes congestion and accidents. A traffic monitoring system that is capable of detecting, counting and classifying the passed vehicles is needed to provide in advance information to relevant authorities on the road traffic demand. Vehicle detection is the key task in this area and vehicle counting and classification are two important applications. This paper introduces the proposed method and its efficiency for use in traffic monitoring systems.**

Index Terms— **Vehicle detection, Background subtraction, Vehicle classification, Vehicle counting.**

I. INTRODUCTION

Traffic surveillance system is a very important a part of Intelligent Transport System. An Intelligent Transport System (ITS) is the application that includes Electronic, Computer and Communication technologies into vehicles and roadways for analysis of traffic conditions, reducing congestion and enhancing flexibility [1]. For many traffic monitoring systems, three major stages are to estimate the specified traffic parameters. They are Vehicle detection, count and Classification.

Videos or images prepared by traffic cameras installed over the roads or on the roadside. Different traffic parameters such as vehicle type, the number of vehicles, traffic density and even traffic accident information can be extracted only using traffic videos or images in a short time.

Vehicle Detection is often one of the first tasks in computer vision application with stationary camera. After a vehicle is detected, other applications can be applied more easily [2].

In this system, the object is detected by pixel wise subtraction between the current frame and the background frame. Using some threshold limit, all pixels belonging to object (that are not present in the background image) are detected. After detection of vehicle, we can count the vehicles by made an imagination line on video. Whenever the vehicle crosses the line, automatically the count will be increase. The main goal of vehicle classification is to categorize the detected vehicles into their respective classes.

II. BACKGROUND SUBTRACTION

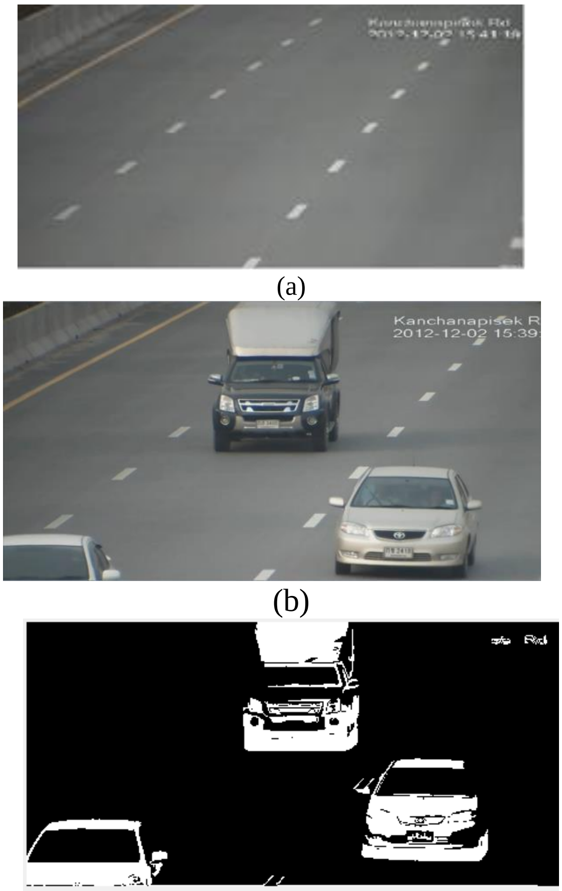
Identifying moving objects from a video sequence is a basic and important task in many computer-vision applications. Background subtraction which is also known as Foreground Detection, is a technique within the field of image processing and computer vision where in an images foreground is extracted for more processing (object recognition etc.). Generally regions of interest are objects (humans, cars, text etc.) in its foreground. A common approach is to perform background subtraction, which identifies moving objects from the portion of a video frame that differs significantly from a background model.

The principle in the approach is that of detecting the moving objects from the difference between the current frame and a frame of reference, typically known as “background image”, or “background model”. Background subtraction provides necessary clues for various applications in computer vision, for example surveillance, tracking or human poses estimation. However, background subtraction is usually based on a static background hypothesis [3].

There are many challenges in developing a good background subtraction algorithm. First, it should be robust against changes in illumination. Second, it should avoid detection of non-stationary background objects [4].

III. VEHICLE DETECTION

Object detection is typically accomplished by a simple background by current frame differencing and then followed by threshold. The main idea here is to make a subtraction between pixels of the background frame and that of the current frame. The pixels having value greater than certain threshold is considered to belong to the object (detected vehicle) as shown in figure 1. We use four distinct steps to detect pixels belonging to moving vehicles.



(a)

(b)

(c)

Figure 1: Vehicle Detection: (a) averaged background (b) masked current frame containing objects in the detection zone (c) blobs of detected vehicles.

The first step in the proposed vehicle detection method is to construct a binary mask that defined the detection range. The mask "M" has same size that of video frames in the region corresponding to the detection area and zeros elsewhere. Next, we multiply both the background and the current image with the mask figure 1. (b) This way the areas outside the detection region are simply eliminated or rejected (dark areas) [4]. Then the background subtraction technique is applied to detect locations within the current image that have values greater than the set threshold.

IV. VEHICLE CLASSIFICATION

In the classification step, we classify vehicles into three classes: small (e.g. car), medium (e.g. van) and large (e.g. bus and trunk). To reach this goal, two features are extracted to differentiate between different vehicle types. First, a length-based feature is computed that is very useful for classifying vehicles according to their size [9]. In the field of pattern recognition, a classifier is used to identify the correct class of a given object based on some classification rules and characteristics of the object, which are also called feature vectors. The main goal of this unit is to determine which category the passing vehicle belongs to. The local binary pattern (LBP) operator is a powerful feature extractor which transforms an image into an integer labels statistics. Prior to the feature extraction process, some image pre-processing steps were applied to standardized and enhance the images.

Local binary pattern (LBP) is to extract unique attributes of each object. The local binary pattern (LBP) was first introduced as grey- scale and rotation invariant texture descriptor. The basic Local binary pattern operator labels the pixels Pn for (n=0,1,....7) of an image using thresholding a 3 x 3 neighbourhood of each pixel with the value of the centre pixel Pc and binary number is considered as the result. Given a pixel at location (xc, yc) which is the resulting LBP at that location can be expressed as follows

$$LBP_{(x_c, y_c)} = \sum_{n=0}^{7} S(P_n - P_c)2^n \qquad (1)$$

Where Pc is the grey-level value of the centre pixel and P_n are its eight surrounding neighbours and S is given as

$$S(P_n, P_c) = \begin{cases} 1 & \text{if } P_n > c \\ 0 & \text{otherwise} \end{cases} \qquad (2)$$

The histogram of the labels computed over each region can be used as local primitive descriptors, which describe the local changes in the region such as; flat area, curves, edges, spots etc. In this, the procedure for extracting the LBP descriptors for vehicle representation is implemented as follows: first, the each processed image is partitioned into 36 regions. Second, the LBP histogram from every region was computed. Third, the histogram ratio h_r and maximum histogram value h_m for each region is determined using equations (3) and (4). Finally, the 36 h_r and 36 h_m from all the regions were concatenated into one feature vector.

$$h_r = \frac{\sum_{i=(k/2)+1}^{k} h_{(i)}}{\sum_{i=1}^{k/2} h_{(i)}}$$

h_m = j , j= arg {max $h_{(i)}$ } (4)

$$V_{LBP} = [h_{r1}, h_{r2},\ldots h_{r36}, h_{m1}, h_{m2},\ldots h_{m36}, a, b_1, b_2, b_3, b_4, c] \qquad (5)$$

The formed feature vectors are then passed to linear classifier to categorize them into their respective categories. Linear discriminate analysis (LDA) attempts to classify a given input object into two or more categories based on features that characterize them, LDA attempts to find linear decision boundaries from the features space that best separate the objects classes.

This is achieved by maximizing the between class scatter matrix while minimizing the within class scatter matrix. Mathematically, the scatter matrices are defined as follows:

$$S_W = \sum_j \sum_i (x_i - m_j)(x - m_j)^T \qquad (6)$$

$$S_B = \sum_{C}^{C \; i \in c} (x_i - m)(x_i - \bar{m}) \qquad (7)$$

And the class separation measure is given by:

$$P_i = \frac{|S_W|}{|S_B|} \qquad (8)$$

Where, SW and SB stand for within class and between scatter matrices

respectively, ni is the range of training samples in class i, c is the number of class labels, mi is samples mean of class i, xi stands for i th class sample set and xj represents the jth object of that class. |SW| and

|SB| indicate the determinants of within and between class matrices.

V. VEHICLE COUNTING

For counting vehicles, only one counting line is used. A line in the frame is defined where vehicles are to be detected. Whenever the vehicle crosses the line, automatically the count will be increased.

The calculation of accuracy is shown in equation (9),

Accuracy in % = (Recognition number / actual number) X 100 (9)

Where, Recognition number = number of vehicles counted by the system, Actual number = number of vehicles observed in the frame.

CONCULUSTION

The proposed system consists of vehicle detection, vehicle classification and counting of vehicles. This system will be implemented on a video sequence of frames recorded from a static camera. The vehicles are detected using background subtraction and thresholding approach. The vehicles are classified into different types based on LDA classifier. The vehicle count is determined by drawing an imaginary line on the input frame.

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